EDITORS' CHOICE

edited by Stella Hurtley

IMMUNOLOGY

Deactivation by Degrees

The cell-surface tyrosine phosphatase, CD45, provides critical regulation of lymphocyte activation. By dephosphorylating inhibitory tyrosine residues on protein tyrosine kinases (PTKs), CD45 facilitates signaling through the T cell receptor. This phosphatase activity is constitutive in the CD45 monomer but is down-regulated through dimerization.

CD45 is expressed as distinct isoforms, generated through alternative exon splicing of the extracellular portion of the molecule. Xu and Weiss now show that these isoforms are the key to how dimer formation is regulated. The smallest isoform (CD45RO) dimerizes more readily than its longer counterparts, correlating with reduced levels of T cell activation and reduced levels of posttranslational modification by O-linked glycosylation and sialylation. Thus, longer isoforms, which are more prevalent on resting T cells, appear to be preferentially maintained as active monomers because increased sugars would impede dimer formation. Production of smaller isoforms after T cell activation would thus promote dimerization, reducing CD45 phosphatase activity and dampening down T cell responses. — SJS

Nature Immunol. **3**, 764 (2002).

GEOLOGY

Pangea Weather Report

The final assembly of the supercontinent Pangea, toward the end of the Paleozoic Era, built up an enormous, high-standing land mass that straddled Earth's equator. Those were excellent conditions for the development of a monsoon in the supercontinent's equatorial regions, and paleoclimate models have suggested that a transition from zonal to monsoonal circulation patterns had probably taken place by the early Permian Period, approximately 280 million years ago.

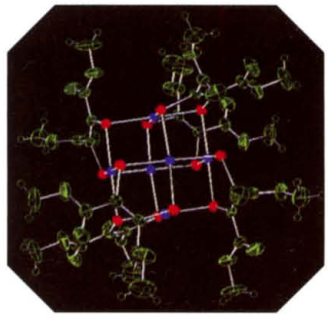
Now Soreghan *et al.* present some persuasive geological evidence for such a transition. They employed an ingenious tracer: the isotopic ages of detrital zircons in Upper Paleozoic loessites (rocks formed from deposits of windblown silt) in the southwestern United States, which marks the late Paleozoic location of western equatorial Pangea. Tying the isotopic ages to regional source rocks exposed during the late Paleozoic, they inferred predominant northeasterly winds during the middle Pennsylvanian Period (290 to 300 million years ago), but a combination of westerly and easterly wind patterns during the early Permian, a pattern consistent with a shift from zonal circulation to a seasonal monsoon. — SW

Geology **30**, 695 (2002).

CHEMISTRY

Charging Ahead

Dithiolenes, which contain the –S–C=C–S– group, can form complexes with transition metals that display unusual magnetic or redox properties and can provide insights into the reactivity of metal-sulfur clusters in enzymes. Normally, if the complex has only dithiolene ligands, all of the potential sites



A view of the cube shape showing Pd (blue) and S (red) atoms.

for ligand binding are occupied: The compound is coordinately saturated.

Beswick *et al.* now report on the synthesis and characterization of an air-stable palladium-dithiolene complex in which six $Pd\text{-}S_2C_2(COOCH_3)_2$ units adopt a slightly distorted cube-octahedron structure. The Pd atoms occupy the center of the cube's faces and the S atoms occupy the midpoints of the edges, leaving the center of the cube and the opposite site on each Pd atom unoccupied. Cyclic voltammetry studies show that the neutral complex can be reduced reversibly to form the 4^- anion. This stable unsaturated cluster should provide a useful starting point for the synthesis of related compounds. — PDS

J. Am. Chem. Soc. 10.1021/ja026079k (2002).

ASTROPHYSICS

Planets in the Mist

T Tauri stars are considered active adolescents in stellar terms (less than 10 million years old). When they grow up, they will become solar-type stars. Classical T Tauri stars are less than 1 million years old and possess a circumstellar disk from which gaseous giant planets may form. It has been thought that it would take more than 1 million years to

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CREDITS: (TOP) BESWICK *ET AL.*, *J. AM. CHEM. SOC.* 10.1021/JA026079K (2002); (BOTTOM, COUNTERCLOCKWISE) (FIRST TWO IMAGES) DOUG WECHSLER/VIREO; SAM FRIED/VIREO; T.J. ULRICH/VIREO

Darwin's finches.

ECOLOGY/EVOLUTION

Radiation Revised

With their diverse bill shapes and ecological habits, Darwin's finches—13 species from the Galápagos Islands and 1 from Cocos Island—serve as a classic example of adaptive radiation. Understanding the evolution of the group and its morphologies has been handicapped by a lack of agreement about these finches' closest living relatives. Burns *et al.* analyzed cytochrome b mitochondrial DNA sequences from the finches, sister taxa, and potential outgroups within the finch-tanager tribe. Darwin's finches form a clade within a larger, well-supported monophyletic group of species that build domed nests. Most of these close relatives are endemic to Caribbean islands and not found in South America. The relatives have a diversity of bill morphologies and feeding behaviors similar to those of Darwin's finches, and this diversity also evolved rapidly. The parallel courses may reflect strong selection as birds colonized islands with vacant niches, a developmental-genetic architecture inherited from the common ancestor, or both. In any case, it appears that the key change in the clade's history occurred before its arrival in the Galápagos. — ShJS

Evolution **56**, 1240 (2002).

form a planet, and classical T Tauri stars have been thought to have lost their circumstellar disks, becoming weak-lined (naked or diskless) T Tauri stars, precluding the possibility of planet formation.

Bary *et al.* have now detected emission from excited molecular hydrogen coming from within 100 astronomical units of a naked T Tauri star, DoAr 21. Thus, DoAr 21 may still possess a circumstellar disk, and planets may have time to form around these older T Tauri stars. For this and similar T Tauri stars, planetary precursors or planetesimals may be cloaking the disks, making them difficult to detect. — LR

Astrophys. J. Rapid Release 25 July 2002 [astro-ph/0207626].

APPLIED PHYSICS

Revealing the Invisible

Terahertz radiation, or T rays, lies in the relatively unexplored and little-used region of the electromagnetic spectrum between the far infrared and microwave wavelengths. This non-ionizing radiation provides the potential of submillimeter resolution and can pass straight through plastic, paper, and clothing. Much research is being directed toward the development of T-ray sources and detectors, particularly for applications in medical imaging and security scanning systems.

Ferguson *et al.* present a technique using a pulsed T-ray source. By taking two-dimensional snapshots at various angles with the T-rays incident upon samples obscured by opaque materials, images were generated using conventional computational tomographic techniques to form a three-dimensional reconstruction of the hidden object. The ability simultaneously to probe the sample's optical properties should provide a powerful technique for noninvasive security screening and medical diagnostics. — ISO

Optics Lett. **27**, 1312 (2002).

ECOLOGY/EVOLUTION

Tree Building

The history of life on earth and the relationships of organisms to one another are commonly expressed in the form of branching phylogenetic trees. However, finding the optimal phylogenetic tree for a group of organisms is a computational headache that becomes ever more painful with the number of taxa involved. The number of possible trees runs into billions with as few as 10 taxa, so phylogeneticists have developed "maximum likelihood" methods that find one or several near-optimal trees much faster than the perfect, correct tree. Even so, such methods are expensive in terms of computational time and power.

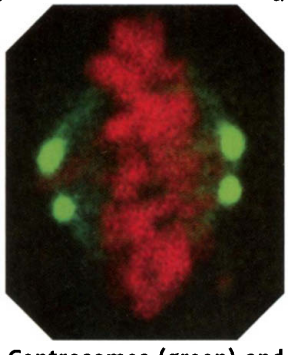
Lemmon and Milinkovitch have developed an algorithm that promises radical improvements in the speed and efficiency with which maximum-likelihood trees are found. Their method, called the metapopulation genetic algorithm, yields maximum-likelihood trees from nucleotide sequence data from hundreds of taxa on a normal desktop computer in a working day. If widely applicable, this method opens opportunities for a surge of studies of large phylogenies and a new depth of understanding of the intricacies of the evolutionary relationships between organisms. — AMS

Proc. Natl. Acad. Sci. U.S.A. **99**, 10516 (2002).

CELL BIOLOGY

Checking Centrosomes

Getting cell division right is vital. Aneuploidy, the loss or addition of a single chromosome, can be lethal or result in uncontrolled growth. A high degree of aneuploidy is seen in many human tumors and correlates with a poor prognosis. During cell division in normal cells, two centrosomes help to form the mitotic spindle poles. The mitotic spindle directs the correct segregation of chromosomes. Like chromosomes, centrosomes are duplicated once during each cell cycle. This duplication is tightly regulated: Additional copies of the centrosomes can cause the formation of multiple spindles, mis-segregation, and aneuploidy.



Centrosomes (green) and chromosomes (red) during mitosis of tetraploid cells.

CREDIT: BOREL *ET AL., PROC. NATL. ACAD. SCI. U.S.A.* **99**, 9819 (2002)

Borel *et al.* show how centrosome number can become amplified. First, defective cells inappropriately receive four rather than two copies of each chromosome, as well as extra centrosomes, because of mis-segregation. If these tetraploid cells fail to arrest their growth, the additional centrosomes cluster at a single spindle pole in the subsequent cell division, forming a regular two-pole spindle and maintaining the abnormal chromosome number. At each division, cells possessing such supernumerary centrosomes have the potential to form multiple spindle poles and aberrantly segregate their chromosomes, resulting in high levels of aneuploidy. — GR

Proc. Natl. Acad. Sci. U.S.A. **99**, 9819 (2002).